United States Department of Agriculture
Forest Service
Southwestern Region
Forest Health
Arizona Zone Office
2500 S. Pine Knoll Drive
Flagstaff, AZ 86001-6381
FAX (928) 556-2130
Voice (928) 556-2073

File Code: 3420
Date: October 23, 2008

Dennis Casper
Montezuma Castle National Monument
P. O. Box 219
Camp Verde, AZ 86322

Dear Dennis:

This letter summarizes the findings of the hazard tree survey you and I conducted on September 17, 2008, in five areas of Montezuma Well: (1) the picnic area; (2) the trail downstream from picnic area; (3) the trail in the riparian buffer zone from the picnic area; (4) the trail at the outlet of the well; and (5) the administration trail along the Montezuma Well irrigation ditch from the outlet trail to the picnic area. This letter provides a summary of our observations. The specifics on tree location and recommended actions are included in the enclosed data sheets we completed during our survey.

Hazard Tree Survey

Our formal hazard tree survey consisted of evaluating all trees for defects within range of the picnic area and trails mentioned above. A tree is hazardous if it has both a structural defect that could cause the tree to fail, and a target (e.g. people or property) it could strike when it fails. The main boles and exposed roots of trees were examined for outward signs of decay, such as wounds. Tree crowns were also examined for limb and leader defects. The structure (size and lean) of limbs are considered due to the propensity of large limbs, especially those of cottonwood trees, to fail. A tree failure rating is qualified as high, medium, or low depending on the presence and severity of a defect. Sometimes a tree failure rating is for part of the tree, such as a large dead limb, rather than the whole tree. A target rating, which is also qualified as high, medium, or low, describes the likelihood of a person, their property, or a structure being located under a tree when it fails.

Figure 1. A large crown snapped off from the main trunk of a cottonwood tree earlier this year.

The mix of riparian tree species and sizes is similar in all areas surveyed. The dominant species are Frémont cottonwood (*Populus fremontii* S. Watson), velvet ash (*Fraxinus velutina* Torr.), and Arizona sycamore (*Platanus wrightii* S. Watson). We saw several very large older decadent trees with signs of advanced internal decay. Fortunately, there are also young vigorous trees that are structurally sound and are becoming good replacement trees that provide valuable shade.

Table 1. Summary of Hazard Tree Survey in Montezuma Well.

Area Surveyed	Dead Limbs	Dead Tree or Live Tree with Severe defect	Low Level Defect Monitor Annually	Dangling Limb	Totals
Picnic Area (High Use)	7	1	4	0	12
Trail Downstream of Picnic Area (Low Use)	4	3	1	2	10
Trail to Riparian Buffer (Moderate Use)	0	8	0	0	8
Trail at Outlet (High Use)	1	0	0	0	1
Trail from Outlet to Picnic Area (Low Use)	8	6	1	1	16
Totals	22	18	6	3	47

We identified 47 hazard trees; 30 cottonwood, 13 ash, 3 sycamore and one willow tree. The breakdown of hazard trees by area and type of hazard is shown in Table 1. Those located in the picnic and outlet trail areas are in high use or high target areas; those located along trails are considered to be in low to moderate use (target) areas. Twenty-two trees are hazardous due to large dead limbs; these can be mitigated with pruning. Eighteen trees are recommended for complete removal because they are either dead or so severely decayed that failure is imminent. It is difficult to predict exactly when a dead tree will fail. The main factors influencing deterioration rates are tree size, tree species, and the environment. The important fact is that all dead trees eventually fail and removal should take place while it is still safe for the sawyer. Six trees were identified as having structural defects that are not believed to pose imminent hazards but were marked to be monitored annually with no immediate action recommended. Three trees had dead limbs that had dropped from their original attachment and are now precariously

dangling from other limbs. Another option that can be considered to mitigate for tree hazards is to remove the target by closing an area to use.

Vegetation Management Planning

Living trees and other vegetation that make Montezuma Well so attractive did not happen completely by chance, as evidenced by tree planting that occurred in the picnic area within the last 25 years. Developed sites should have an organized plan to replace lost trees with species that provide quality shade, are resilient to insects and disease, and are safe. This plan could include the planting of low hazard tree species native to the Montezuma Well area. The key is to plant trees that form low profile crowns and not tree species that form large lateral limbs. If the latter is selected than they need to be replaced more often. Once seedlings are established, use deep infrequent watering practices so trees establish deep wide roots.

Figure 2. Split trunk with advanced internal decay.

Cottonwoods are not a suitable choice in high use areas. They are short-lived species that grow very fast and are extremely susceptible to decay. Cottonwoods are known to drop large branches without warning. Proper pruning techniques could be used to prolong the life of cottonwood trees present in the picnic area. Proper pruning cuts are made at a point at which one branch or twig attaches to another. When a tree is pruned improperly, new branches form from epicormic sprouts but they are weakly attached to a stem. The original stem starts to decay because of the wound created from improper pruning. The epicormic sprouts grow into large limbs quickly, providing the necessary shade, but soon fail due to the precarious attachment.

Ash and sycamore trees also require careful pruning and branch selection during the first 15 years after planting to ensure good, strong trunk and branch development. Some horticulturists do not recommend planting ash due to the high pruning requirement and susceptibility to breakage.

Arizona walnut (*Juglans major* Torr.), western hophornbeam (*Ostrya knowltonii* Sarg.), and netleaf hackberry (*Celtis reticulata* Torr.) are low hazard tree species that exist in nearby riparian areas. Arizona walnut can reach a height of 50 feet, while the maximum height of hophornbeam and hackberry is about 30 feet. These are medium to low profile species that are fairly resistant to decay.

Living trees in Montezuma Well developed sites are reasonably well protected from soil and root compaction. The irrigation system in the picnic area could be improved to limit pooling around the base of trees, which can kill roots systems.

Summary

Although there are a number of very large decadent trees in Montezuma Well area, there are a greater number of young trees that are providing valuable shade. Once the hazard trees we identified are mitigated, a vegetation management plan can be designed that can chart a course for developing a safe and shady environment to continue into the future.

If you have any questions about this report or need further assistance, please contact me at (928) 556-2075 or by email at mfairweather@fs.fed.us.

Sincerely,

/s/ Mary Lou Fairweather
MARY LOU FAIRWEATHER
Forest Pathologist, Forest Health, Arizona Zone